codex alimentarius commission

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS

WORLD HEALTH ORGANIZATION

JOINT OFFICE: Viale delle Terme di Caracalla 00100 ROME Tel: 39 06 57051 www.codexalimentarius.net Email: codex@fao.org Facsimile: 39 06 5705 4593

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TO: Codex Contact Points
Interested International Organizations

FROM: Secretary, Codex Alimentarius Commission
Joint FAO/WHO Food Standards Programme
FAO, 00100 Rome, Italy

SUBJECT: **Analytical Terminology for Codex Use (Procedural Manual)**

DEADLINE: **5 February 2004**

COMMENTS: To:

Secretary
Codex Alimentarius Commission
Joint FAO/WHO Food Standards Programme – FAO
Viale delle Terme di Caracalla
00100 Rome, Italy
Fax: +39 (06) 5705 4593
E-mail: codex@fao.org

Copy to:

Dr. Mária Váradi,
Central Food Research Institute (KÉKI)
Herman Ottó út 15,
H-1022 Budapest
Fax : +361 212 9853
or 361 355 8928
Email : m.varadi@cfri.hu

The 24th Session of the Committee on Methods of Analysis and Sampling, while considering the IUPAC Harmonized Guidelines for Single-Laboratory Validation of Methods of Analysis, agreed to initiate the revision of the Definitions contained in the Codex Procedural Manual (Analytical Terminology for Codex Use) (ALINORM 03/23, para. 95). This was approved by the 26th Session of the Commission as new work (ALINORM 03/41, para. 138-140 and Appendix VIII).

Comments are therefore requested on the current Analytical Terminology for Codex Use, as attached in Annex 1, for consideration by the 25th Session of the Committee on Methods of Analysis and Sampling (Budapest, Hungary, 8-12 March 2004).

Governments and international organizations wishing to provide comments should do so in writing, preferably by email, to the above addresses **before 5 February 2004**.

GUIDELINES FOR THE INCLUSION OF SPECIFIC PROVISIONS IN CODEX STANDARDS AND RELATED TEXTS

PRINCIPLES FOR THE ESTABLISHMENT OF CODEX METHODS OF ANALYSIS

ANALYTICAL TERMINOLOGY FOR CODEX USE

Result: The final value reported for a measured or computed quantity, after performing a measuring procedure including all sub-procedures and evaluations.

Notes:

When a result is given, it should be made clear whether it refers to:

- the indication [signal];
- the uncorrected result;
- the corrected result; and
- whether several values were averaged.

A complete statement of the result of a measurement includes information about the uncertainty of measurement.

Specificity: The property of a method to respond exclusively to the characteristic or analyte defined in the Codex standard.

Notes:

Specificity may be achieved by many means: It may be inherent in the molecule (e.g., infrared or mass spectrometric identification techniques), or attained by separations (e.g., chromatography), mathematically (e.g., simultaneous equations), or biochemically (e.g., enzyme reactions). Very frequently methods rely on the absence of interferences to achieve specificity (e.g., determination of chloride in the absence of bromide and iodide).

In some cases specificity is not desired (e.g., total fat, fatty acids, crude protein, dietary fibre, reducing sugars).

Accuracy (as a concept): The closeness of agreement between the reported result and the accepted reference value.

Notes:

The term accuracy, when applied to a set of test results, involves a combination of random components and a common systematic error or bias component. When the systematic error component must be arrived at by a process that includes random error, the random error component is increased by propagation of error considerations and is reduced by replication.

Accuracy (as a statistic): The closeness of agreement between a reported result and the accepted reference value.

Notes:

Accuracy as a statistic applies to the single reported final test result; accuracy as a concept applies to single, replicate, or averaged values.

***Trueness*:** The closeness of agreement between the average value obtained from a series of test results and an accepted reference value.

Notes:

The measure of trueness is usually expressed in terms of bias.

Trueness has been referred to as “accuracy of the mean”.

***Bias*:** The difference between the expectation of the test results and an accepted reference value.

Notes:

Bias is the total systematic error as contrasted to random error. There may be one or more systematic error components contributing to bias. A larger systematic difference from the accepted reference value is reflected by a larger bias value.

When the systematic error component(s) must be arrived at by a process that includes random error, the random error component is increased by propagation of error considerations and reduced by replication.

***Precision*:** The closeness of agreement between independent test results obtained under stipulated conditions.

Notes:

Precision depends only on the distribution of random errors and does not relate to the true value or to the specified value.

The measure of precision is usually expressed in terms of imprecision and computed as a standard deviation of the test results. Less precision is reflected by a larger standard deviation.

"Independent test results" means results obtained in a manner not influenced by any previous result on the same or similar test object. Quantitative measures of precision depend critically on the stipulated conditions. Repeatability and reproducibility conditions are particular sets of extreme conditions.

Repeatability [Reproducibility]: Precision under repeatability [reproducibility] conditions.

Repeatability conditions: Conditions where independent test results are obtained with the same method on identical test items in the same laboratory by the same operator using the same equipment within short intervals of time.

***Reproducibility conditions*:** Conditions where test results are obtained with the same method on identical test items in different laboratories with different operators using different equipment.

Notes:

When different methods give test results that do not differ significantly, or when different methods are permitted by the design of the experiment, as in a proficiency study or a material-certification study for the establishment of a consensus value of a reference material, the term "reproducibility" may be applied to the resulting parameters. The conditions must be explicitly stated.

Repeatability [Reproducibility] standard deviation: The standard deviation of test results obtained under repeatability [reproducibility] conditions.

Notes:

Repeatability [Reproducibility] standard deviation is a measure of the dispersion of the distribution of test results under repeatability [reproducibility] conditions.

Similarly "repeatability [reproducibility] variance" and "repeatability [reproducibility] coefficient of variation" could be defined and used as measures of the dispersion of test results under repeatability [reproducibility] conditions.

Repeatability [Reproducibility] limit: The value less than or equal to which the absolute difference between two test results obtained under repeatability [reproducibility] conditions may be expected to be with a probability of 95%.

Notes:

The symbol used is r [R].

When examining two single test results obtained under repeatability [reproducibility] conditions, the comparison should be made with the repeatability [reproducibility] limit r [R] = 2.8 sr[sR].

When groups of measurements are used as the basis for the calculation of the repeatability [reproducibility] limits (now called the critical difference), more complicated formulae are required that are given in ISO 5725-6:1994, 4.2.1 and 4.2.2.

Interlaboratory Study: A study in which several laboratories measure a quantity in one or more "identical" portions of homogeneous, stable materials under documented conditions, the results of which are compiled into a single document.

Notes:

The larger the number of participating laboratories , the greater the confidence that can be placed in the resulting estimates of the statistical parameters. The IUPAC-1987 protocol (Pure & Appl. Chem., **66**, 1903-1911(1994)) requires a minimum of eight laboratories for method-performance studies.

Method-Performance Study: An interlaboratory study in which all laboratories follow the same written protocol and use the same test method to measure a quantity in sets of identical test samples. The reported results are used to estimate the performance characteristics of the method. Usually these characteristics are within-laboratory and among-laboratories precision, and when necessary and possible, other pertinent characteristics such as systematic error, recovery, internal quality control parameters, sensitivity, limit of determination, and applicability.

Notes:

The materials used in such a study of analytical quantities are usually representative of materials to be analyzed in actual practice with respect to matrices, amount of test component (concentration), and interfering components and effects. Usually the analyst is not aware of the actual composition of the test samples but is aware of the matrix.

The number of laboratories, number of test samples, number of determinations, and other details of the study are specified in the study protocol. Part of the study protocol is the procedure which provides the written directions for performing the analysis.

The main distinguishing feature of this type of study is the necessity to follow the same written protocol and test method exactly.

Several methods may be compared using the same test materials. If all laboratories use the same set of directions for each method and if the statistical analysis is conducted separately for each method, the study is a set of method-performance studies. Such a study may also be designated as a method-comparison study.

Laboratory-Performance (Proficiency) Study: An interlaboratory study that consists of one or more measurements by a group of laboratories on one or more homogeneous, stable, test samples by the method selected or used by each laboratory. The reported results are compared with those from other laboratories or with the known or assigned reference value, usually with the objective of improving laboratory performance.

Notes:

Laboratory-performance studies can be used to support accreditation of laboratories or to audit performance. If a study is conducted by an organization with some type of management control over the participating laboratories—organizational, accreditation, regulatory, or contractual—the method may be specified or the selection may be limited to a list of approved or equivalent methods. In such situations, a single test sample is insufficient to judge performance.

A laboratory-performance study may be used to select a method of analysis that will be used in a method-performance study. If all laboratories, or a sufficiently large subgroup, of laboratories , use the same method, the study may also be interpreted as a method-performance study, provided that the test samples cover the range of concentration of the analyte.

Laboratories of a single organization with independent facilities, instruments, and calibration materials, are treated as different laboratories.

Material-Certification Study: An interlaboratory study that assigns a reference value ("true value") to a quantity (concentration or property) in the test material, usually with a stated uncertainty.

Note:

A material-certification study often utilizes selected reference laboratories to analyze a candidate reference material by a method(s) judged most likely to provide the least-biased estimates of concentration (or of a characteristic property) and the smallest associated uncertainty.

Applicability: The analytes, matrices, and concentrations for which a method of analysis may be used satisfactorily to determine compliance with a Codex standard.

Note:

In addition to a statement of the range of capability of satisfactory performance for each factor, the statement of applicability (scope) may also include warnings as to known interference by other analytes, or inapplicability to certain matrices and situations.

Sensitivity: Change in the response divided by the corresponding change in the concentration of a standard (calibration) curve; i.e., the slope, s_i, of the analytical calibration curve.

Note:

This term has been used for several other analytical applications, often referring to capability of detection, to the concentration giving 1% absorption in atomic absorption spectroscopy, and to ratio of found positives to known, true positives in immunological and microbiological tests. Such applications to analytical chemistry should be discouraged.

A method is said to be sensitive if a small change in concentration, c, or quantity, q, causes a large change in the measure, x; that is, when the derivative dx/dc or dx/dq is large.

Although the signal may vary with the magnitude of c_i or q_i, the slope, s_i, is usually constant over a reasonable range of concentrations. s_i may also be a function of the c or q of other analytes present in the sample.

***Ruggedness*:** The ability of a chemical measurement process to resist changes in results when subjected to minor changes in environmental and procedural variables, laboratories, personnel, etc.

TERMS TO BE USED IN THE CRITERIA APPROACH

Detection Limit: The detection limit is conventionally defined as field blank + 3σ, where σ is the standard deviation of the field blank value signal (IUPAC definition).

However, an alternative definition which overcomes most of the objections to the above approach (i.e. the high variability at the limit of measurement can never be overcome) is to base it on the rounded value of the reproducibility relative standard deviation when it goes out of control (where 3 σ_R = 100%; σ_R = 33%, rounded to 50% because of the high variability). Such a value is directly related to the analyte and to the measurement system and is not based on the local measurement system.

Determination limit: As for detection limit except that 6σ or 10σ is required rather than 3σ.

However, an alternative definition that corresponds to that proposed for the detection limit is to use σ_R = 25%. This value does not differ much from that assigned to the detection limit because the upper limit of the detection limit merges indistinguishably into the lower limit of the determination limit.

Recovery: Proportion of the amount of analyte present or added to the test material which is extracted and presented for measurement.

Selectivity: Selectivity is the extent to which a method can determine particular analyte(s) in mixtures or matrices without interferences from other components.

Selectivity is the recommended term in analytical chemistry to express the extent to which a particular method can determine analyte(s) in the presence of interferences from other components. Selectivity can be graded. The use of the term specificity for the same concept is to be discouraged as this often leads to confusion.

Linearity: The ability of a method of analysis, within a certain range, to provide an instrumental response or results proportional to the quality of analyte to be determined in the laboratory sample. This proportionality is expressed by an a priori defined mathematical expression. The linearity limits are the experimental limits of concentrations between which a linear calibration model can be applied with a known confidence level (generally taken to be equal to 1%).